

WHAT IS CLAIMED IS:

A method for compounding gel-free injection molding feed stock for injection molding net-shape ceramic parts, comprising the steps of:

- a) mixing inorganic particles with non-gel forming water soluble organic binders having molecular weight between 1000 and 1,000,000 and that are between 0.5 weight % and 10 weight % based upon the inorganic particles, along with plasticizers, water and processing aids in a mixer to form a mixture, wherein the non-gel forming water soluble organic binders are composed of high and low molecular weight organic binders, and wherein a weight fraction of the high molecular weight organic binders with respect to the low molecular weight organic binders varies between 0.1 and 0.6;
- b) compounding the mixed inorganic particles and the non-gel forming water soluble organic binders at a high temperature in the range of between 70° and 98° Centigrade, under shear force, to form a homogenous viscous slurry in the range of 5×10^3 and 7×10^4 Pa.sec at a shear rate of 10 sec^{-1} ;
- c) cooling the homogenous viscous slurry to room temperature to form a compounded solid mass;
- d) grinding the compounded solid mass to small pellets to provide feed stock for an injection molding machine;
- e) injection molding the feedstock to produce a green component for subsequent drying; and
- f) sintering to form a net-shape final ceramic part.

2. The method claimed in claim 1, wherein the inorganic particles are Y-TZP ceramic comprising 3 mole % yttria, and have an average particle size ranging from 0.2 to 0.5 μm .

3. The method claimed in claim 1, wherein the inorganic particles are ceramic composite alumina-toughened zirconia, comprising between 5% to 49% by weight of alumina, and have average particle size ranging from 0.2 to 1.0 μm .

4. The method claimed in claim 1, wherein the inorganic powder comprises between about 45% to 90% by weight of the compounded mixture.

5. The method claimed in claim 1, further comprising the step of mixing and heating the water soluble organic binders, plasticizers and water to a temperature between 90-98°C prior to adding the inorganic particles, and decreasing the temperature to a range of between 70-90°C after adding the inorganic particles and mixing for more than 4 hours in a shear mixer.

6. An injection molded net shape product made by the process of claim 1.

7. An injection molding process, comprising the steps of:
a) mixing ceramic powders with non-gel forming water soluble organic binders having a molecular weight distribution between 1000 and 1,000,000 and that are between 0.5 weight % and 10 weight % based upon the inorganic particles, along with plasticizers, water and processing aids in a mixer to form a mixture, wherein the non-gel forming water soluble organic binders are composed of high and low molecular weight organic binders, and wherein a weight fraction of the high molecular weight organic binders with respect to the low molecular weight organic binders varies between 0.1 and 0.6;

b) compounding the mixed ceramic powders at high temperature in the range of between 70° and 98° Centigrade, under shear force, to form a homogenous viscous slurry in the range of 5×10^3 and 7×10^4 Pa.sec at a shear rate of 10 sec^{-1} ;

c) cooling the homogenous viscous slurry to room temperature to form a compounded solid mass;

d) grinding the compounded solid mass to small pellets to provide feed stock for an injection molding machine; and

e) injection molding the feedstock to produce a green component for subsequent drying.

8. The process claimed in claim 7, wherein the ceramic powders are Y-TZP ceramic comprising 3 mole % yttria, and have an average particle size ranging from 0.2 to 0.5 μm .

9. The process claimed in claim 7, wherein the ceramic powders are ceramic composite alumina-toughened zirconia, comprising between 5% to 49% by weight of alumina, and have average particle size ranging from 0.2 to 1.0 μm .

10. The process claimed in claim 7, wherein the ceramic powders comprise between about 45% to 90% by weight of the compounded mixture.

11. The process claimed in claim 7, further comprising the step of mixing and heating the non-gel forming water soluble organic binders, plasticizers and water to a temperature between 90 and 98°C prior to adding the ceramic powders, and decreasing the temperature to a range of between 70-90°C after adding the ceramic powders and mixing for more than 4 hours in a shear mixer.

12. The process of claim 7, wherein the non-gel forming water soluble organic binders include primary binders poly(ethylene oxide), polyvinyl-alcohol, polystyrene sulfonate and its derivatives, hydroxypropyl cellulose, methyl vinyl ether/meleic anhydride copolymer, poly (ethylene glycol) or a mixture thereof.

13. The process of claim 7, wherein the non-gel forming water soluble organic binders are between 3% and 8% by weight of the ceramic powders.

14. The process of claim 7, wherein the water in the mixture is between 30% and 50% by weight of the mixture, and preferably between 35% and 45% by weight of the mixture.

15. The process of claim 7 wherein the homogenous viscous slurry is obtained between 4 and 12 hours.

16. The method claimed in claim 1, wherein the homogenous viscous slurry is obtained between 4 and 12 hours.

17. The method claimed in claim 1, wherein the water in the mixture is between 30% and 50% by weight of the mixture, and preferably between 35% and 45% by weight of the mixture.

18. The method claimed in claim 1, wherein the non-gel forming water soluble organic binders are between 3% and 8% by weight of the inorganic particles.